



GEODYN II is the orbit determination and geodetic parameter estimation software developed and maintained at NASA GSFC. It has been and is being used in a variety of planetary missions (NEAR, Magellan, MGS, Odyssey, Venus Express, MRO, LRO, MESSENGER, GRAIL, Dawn, OSIRIS-Rex; CAESAR). With numerous state-of-the-art force and measurement models, it can be used to achieve navigation and science goals.

'Basics'

- time and frame transformation (incl. relativity)
- ground station position (Earth orientation, solid tide, ocean loading, etc.)
- central body gravity (spherical harmonics, mascons) and tides
- solar system bodies
- solar, albedo, and planetary radiation
- relativistic effects
- external acceleration (e.g., thermal re-radiation)
- full binary asteroid capability

Radiometric data

Measurement types:

- Range observations
- Doppler observations
- VLBI observations
- Δ DOR observations (for cruise/flyby)

modeling of corrections for:

- tropospheric and ionospheric effects
- station position and Earth orientation
- spacecraft antenna phase offset

Image landmark



sensitivities:

- s/c position
- s/c attitude
- camera model
- *a priori* landmark positions

→ goal is to minimize distance between vector and landmark position

Image constraints



sensitivities:

- s/c position
- s/c attitude
- camera model

→ goal is to minimize distance between two vectors

Orientation/Ephemeris

Orientation models:

- analytical: constant, linear and periodic for RA, DEC and W
- dynamical: direct integration of equations of motion from initial state and moments of inertia

Ephemeris models:

- use of a priori trajectory (e.g. JPL/DE) with estimation of Set III corrections
- direct integration of central body concurrently with spacecraft trajectory (and data analysis)

Direct Altimetry



sensitivities:

- s/c position
- s/c attitude
- laser pointing
- *a priori* body shape

→ goal is to minimize difference between measured and computed range

The computed range is the round trip distance from the satellite at transmit time to the location where the ray intersects the DEM back to the satellite at receive time.

Altimetric crossovers



sensitivities:

- s/c position
- s/c attitude
- laser pointing

→ goal is to minimize distance between two altimetric 3D profiles at crossover point

Altimetric constraints



sensitivities:

- s/c position
- s/c attitude
- laser pointing

→ goal is to minimize distance between two altimetric 3D points (in total and radial distance)

GEODYN can simultaneously use all the measurement types outlined above to yield a comprehensive estimate of geophysical parameters of interest (and their correlation): gravity coefficients; orientation and moments of inertia; ephemeris; tidal Love numbers (gravity and shape); center-of-figure to center-of-mass offset; as well as corrections to spacecraft orbit, camera/laser boresight pointing, landmark positions. With full simulation capabilities, GEODYN can also help develop and demonstrate mission and instrument concepts.

The maintenance and development of GEODYN is supported by the Planetary Geodesy ISFM, to ensure the software remains available for data processing and analysis, and to assure it remains state-of-the-art by implementing new geodetic measurements and models.